6. Increased susceptibility in young people

The dielectric properties of tissues indicate how easily material can absorb microwave radiation and determine the tissue's response to an electromagnetic current. The measured properties are the conductivity (σ)—which is directly proportional to the SAR, and the permittivity (ε). Empirical data have shown a difference in the dielectric properties of tissues as a function of age. These differences are mostly due to the higher water content in children's tissues, but they also reflect the physiological development of an organism or tissue that involves structural and biochemical changes. The results of studies on age effects showed that, while the dielectric properties of gray matter do not change with age, other tissues such as white matter and spinal cord vary significantly. More significant results were observed in the case of bone, skull and marrow tissues [17–20].

High resolution computerized models based on real human imaging data suggest that the higher conductivity and higher permittivity in children's brain tissues, together with their thinner skulls and smaller heads, will lead to higher SARs in their brains from microwave frequencies when compared to adults. Exposure to other body organs from cellphones carried in the pockets is common. Effects on other body organs are studied as well as in utero effects on the fetus [21–29].

These and many other studies provide important evidence that biological effects from mobile phone radiation occur with contemporary phones and thus strengthen the case for expecting these devices to have impacts on health.

A letter to the U.S. Congress by the American Academy of Pediatrics, dated 12 December 2012 notes:

"Children are disproportionately affected by environmental exposures, including cell phone radiation. The differences in bone density and the amount of fluid in a child's brain compared to an adult's brain could allow children to absorb greater quantities of RF energy deeper into their brains than adults. It is essential that any new standards for cell phones or other wireless devices be based on protecting the youngest and most vulnerable populations to ensure they are safeguarded through their lifetimes."

7. Shortage in oncology services

Projected supply for oncology services in the U.S. is not expected to meet demand in the near future and is already inadequate. In 2007 a study for the American Society of Clinical Oncology (ASCO, 2007) [projected that "supply is projected to only increase 20% between now and 2020, and capacity for oncologist visits is projected to rise even less at 14%. Demand for oncologist services is projected to grow by 48% during that same time" [30]. The projections were based on current cancer rates and delivery patterns applied to the expected U.S. population in 2020. Unless there is a dramatic change in cancer care treatment or delivery between now and 2020, the nation is expected to face an acute shortage of oncologists." Thus, the number of available oncologists is about half those projected to be needed by 2020.

If the elevated risks found in studies of young cellphone users were to occur globally, then rates of glioma could rise significantly from about 3 to 12 per 100,000. In addition to the direct medical costs involved, there will be substantial indirect costs for society, including loss of productivity of those at the peak of their professional lives and incalculable family impacts. This could create a devastating impact on the capacity to deliver neuro-oncology services.

8. Policy implications and research priorities

A new question that these findings raise is profound: could mobile phone radiation not only cause brain cancers, but could its continued use shorten the lives of those who develop these and other diseases? This prospect raised by the analysis of Hardell et al. should be sufficiently concerning to prompt health authorities around the world to issue advice, especially to their incident cancer patients, to reduce exposures from mobile and cordless phones, while further work continues to explore this matter.

Other important research questions that should be addressed include the following: Could exposures to mobile phone radiation play a role in the unusual rise in autism? Does the increase in deep vein thrombosis as the leading cause of death in pregnancy have any connection with the growing use of mobile phones during pregnancy? Could blood clots such as that developed by Secretary of State Hillary Clinton after a fall be more frequent in those who are also heavy cellphone users? Are tinnitus and other hearing problems associated with longer-term mobile phone use?

About half of the world's mobile phone users are under age 30 today and live in developing countries. If the risks reported by Hardell et al. were to occur in that population, the capacity to provide health care would be overwhelmed. This year, the Central Brain Tumor Registry of the United States (CBTRUS) estimates that in the U.S. about 10,000 people will develop glioma. CBTRUS reports that gliomas constitute 1 of every 3 brain tumors and 4 out of every 5 malignant brain tumors. If current young users of mobile phones face such heavy risks, then several thousand new cases will develop in the U.S. annually. Oncology surgeons, neuro-oncologists, drugs and nurses are already in short supply in many regions of both the developed and developing world. Prognosis for the disease has not changed appreciably, with five-year survival rates being about 5% (CBTRUS, 2012) [31].

Current standards for exposure to radiofrequency fields were set more than fifteen years ago resting on the belief that levels of microwave radiation from mobile phones cannot induce any measureable change in temperature or other biological effect. Recent analyses show that this assumption is no longer tenable. The General Accountability Office (GAO)

recently advised the U.S. Congress that standards for mobile phones should be reassessed (GAO, 2012), noting that no new proposals had been advanced in the past two decades, a period during which both the users and their uses have changed dramatically.

In considering the overall findings on increased risk of brain cancer and mobile phone and other wireless radiation in its 2011 evaluation, IARC Director, Christopher Wild, offered some simple recommendations that have since been widely shared:

"Given the potential consequences for public health of this classification and findings it is important that additional research be conducted into the long-term, heavy use of mobile phones. Pending the availability of such information, it is important to take pragmatic measures to reduce exposure, such as hands-free devices or texting" [32].

9. Liability, simple precautions, and product warnings

Over the past decade, this advice about reducing exposures through simple precautions has been echoed by a growing number of health professionals and regulatory bodies around the world, including the Finnish Radiation and Nuclear Safety Authority, the Health Safety Authority of Britain, the Israeli Health Ministry, the Indian government's Department of Telecom, the Austrian Medical Society, the American Academy of Pediatrics, Environmental Health Trust, Environmental Working Groups, and many others.

With 5.9 billion reported users worldwide, mobile phones constitute a new, ubiquitous and rapidly growing environmental exposure. In 2011, following publication of the Interphone study results, two of the Interphone study researchers including lead author Cardis published an editorial on the potential public health implications of possible brain tumor risk in mobile phone studies [33]. The authors expressed their concern that small increases in risk, especially those found in ipsilateral localized exposure and in long term users are important when considering the huge numbers of people exposed:

"*...The findings in several studies of an increased risk for glioma among the highest users on the side of the head where the phone was used and, in Interphone, in the temporal lobe are therefore important. These are the findings that would be expected if there was a risk, as these are the a priori relevant exposure variables.*"

"*Even a small risk at the individual level could eventually result in a considerable number of tumours and become an important public health issue. Simple and low-cost measures, such as the use of text messages, hands-free kits, and/or the loud-speaker mode of the phone could substantially reduce exposure to the brain from mobile phones.*"

Saracci and Samet's commentary (2010), while less unequivocal, supports this view [3]. Since the risk of greatest interest is lifelong use, possibly beginning in childhood—a pattern of exposure that cannot yet be studied, the authors agree that a precautionary approach to the extent and manner of use of mobile phones may find some support in the elevated risks noted in subjects with the highest exposures.

There are a number of experts who contend that the lack of an overall positive trend in gliomas provides evidence that mobile phone use does not cause brain tumors [34–36]. In addition, some assert that there is no exposure–response relationship, either in terms of the amount of mobile phone use or by localization of the brain tumor, and that this argues against a causal association [37]. But, reviews conducted by groups of researchers from different countries, as well as published policy resolutions and advisories from national authorities such as the Finnish Radiation and Nuclear Safety Authority and the Austrian Medical Society, reach much different conclusions and fully support the need for a precautionary approach regarding risk.

The grounds for taking precautionary steps rest on a growing body of evidence.

Abdus-salam et al., 2008: "*the need for caution is emphasized as it may take up to four decades for carcinogenesis to become fully apparent*" [38].

Myung et al., 2009: "*The current study found that there is possible evidence linking mobile phone use to an increased risk of tumors from a meta-analysis of low-biased case–control studies*" [39].

Levis et al., 2011: "*Our analysis of the literature studies and of the results from meta-analyses of the significant data alone shows an almost doubling of the risk of head tumors induced by long-term mobile phone use or latency*" [40].

Committee on the Environment, Agriculture and Local and Regional Affairs of the Council of Europe (2011): "*[For mobile phones] One must respect the precautionary principle and revise the current threshold values; waiting for high levels of scientific and clinical proof can lead to very high health and economic costs, as was the case in the past with asbestos, leaded petrol and tobacco*" [41].

The Russian National Committee On Nonionizing Radiation Protection (RNCNIRP) "*Urgent measures must be taken because of the inability of children to recognize the harm from the mobile phone use and that a mobile phone itself can be considered as an uncontrolled source of harmful exposure*" [42].

As a sign of the times, manufacturers and businesses are developing ways to promote reductions in radiation as well. One of the fastest growing mobile apps is called tawkon—which provides an algorithm indicating the potential danger from signal strength to those using phones. Globally, sales of cases and headsets tested and confirmed to reduce radiation have grown, indicating market demand for such devices.

Phone manufacturers are also issuing advice on reducing exposure, as these notices from Apple and Samsung indicate:

"To reduce exposure to RF energy, use a hands-free option, such as the built-in speakerphone, the supplied headphones, or other similar accessories. Carry iPhone at least 10 mm away from your body to ensure exposure levels remain at or below the as-tested levels. Cases with metal parts may change the RF performance of the device, including its compliance with RF exposure guidelines, in a manner that has not been testified or certified."

What is missing altogether in the above statement is this previously published advice from Apple that these phones, when carried in the pocket, can exceed the FCC exposure guidelines.

Warning: "iPhone's SAR measurement may exceed the FCC exposure guidelines for body-worn operation if positioned less than 15 mm (5/8 inch) from the body (e.g. when carrying iPhone in your pocket)."

Such advice about safer use no longer appears in a printed pamphlet with iPhones, but can be found on the phones by clicking *settings/general/about/legal/RFexposure*.

Other manufacturers also include more safety advice. Samsung is the number one producer of cellphones in the world today. Their new Convoy 2 phone comes with this advice:

"Your mobile device is not a toy. Do not allow children to play with it because they could hurt themselves and others, damage the device, or make calls that increase your mobile device bill."
"Keep the mobile device and all its parts and accessories out of the reach of small children."

The challenge to public health is how to promote sensible policies now. The focus on brain cancer may be the tip of the iceberg in relation to a host of other serious widespread health, behavioral and social effects from such radiation. Downloadable resources that draw upon advisories developed by experts in many nations are available in several languages at www.ehtrust.org.

10. Practical advice for the public

When it comes to using electronic devices, remember: *Distance is your friend.*

- Don't hold a cellphone directly up to your head. Use a headset or speakerphone when using the device, or a non-metal case that has been independently tested to reduce radiation up to 90%.
- Pregnant women should keep cellphones away from their abdomen and men who wish to become fathers should not keep these phones on while in their pocket.
- Don't allow children to play with or use your cellphone. Older children should use a headset or speakerphone when talking on a cellphone.
- Do not text and drive and only use specially adapted antennas when using mobile phones in cars to avoid absorbing maximum power as the phone moves from one cell system to another. When buying a new car, pay attention that the car has a built-in antenna that reduces your direct exposure.
- Turn off your wireless router at night to minimize exposure to radiation.
- Eat green vegetables and get a good night's sleep in a dark room to enhance natural repair of DNA that may have been damaged by radiation.

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Strengthened Scientific Circumstances further increase necessity for the City's Right-to-Know Ordinance and Justify a Major Public Health Education Campaign on Cell Phone Safety

May 3, 2013

Dear Honorable San Francisco Board of Supervisors:

Norman Yee
John Avalos
Malia Cohen
London Breed
Eric Mar
David Chiu
David Campos
Katy Tang
Jane Kim
Mark Farrell
Scott Wiener

We commend the Board in having passed the right to know ordinance about cell phones in 2010. Recent scientific research conducted since then affirms the wisdom of this proposal. Therefore, in the interest of the public health of the citizens of San Francisco please consider this recently published scientific information (discussed below), **we urge you to vote against the proposed settlement of the lawsuit filed by the Cellular Telephone Industry Association (CTIA)**against the City and County of San Francisco (United States District Court, Northern District of California, Case No. 3:10-cv-03224 (WHA); entitled CTIA - The Wireless Association v. City and County of San Francisco) and continue the litigation in support of the Cell Phone Right-to-Know Law. In particular, please do not authorize any permanent injunction against enforcement of the Cell Phone Right-to-Know Law that was unanimously passed by the SF Board of Supervisors.

Just one week ago, on April 24th the **International Agency for Research on Cancer (IARC) of the World Health Organization issued its Monograph[1] that addresses whether cellular telephone RF EMF radiation presents a risk of cancer to the cell phone users. The IARC re-affirmed its official classification that cellular telephone radiation is a Group 2B carcinogen** along with lead, automobile exhaust and other toxic substances including DDT, heptachlor, styrene and hexachlorobenzene and they now released their 480 page Monograph that provides the details of the basis on the classification in this the **most significant government health report on mobile phone radiation ever published.**

The fact that IARC drew this conclusion is particularly important because IARC has a reputation for being extremely difficult to convince before concluding that anything is a carcinogen. The new WHO IARC Monograph concludes that:

[1] IARC Monograph Non-ionizing Radiation, Part 2:
Radiofrequency Electromagnetic Fields volume 102 http://monographs.iarc.fr/ENG/Monographs/vol102/index.php

"Due to the closer proximity of the phone to the brain of children compared with adults, the average exposure from use of the same mobile phone is higher by a factor of 2 in a child's brain and higher by a factor of 10 in the bone marrow of the skull."[2] *(p. 408)*

"Positive associations have been observed between exposure to radiofrequency radiation from wireless phones and glioma and acoustic neuroma"[3] *(p.421),*

"Radiofrequency electromagnetic fields are possibly carcinogenic to humans (Group 2B)."[4]

This significant announcement by the cancer experts at WHO accompanies among other peer-reviewed research that has found deleterious, non-thermal effects on the brain and other parts of the body, including sperm damage including reducing sperm motility, and causing deformation in surviving spermatozoa.

This WHO conclusion comes on the heels of many other recent sources to the same effect. For example, your attention is respectfully directed to the following new science science that must be carefully reviewed and weighed in protecting the people of SF:

1. In October, 2012, the Italian Supreme Court ruled the Insurance Body for Work (INAIL) must compensate a worker who developed a tumor in the head due to long-term, heavy use of mobile phones on the job. Importantly, the ruling underscored discrepancies between the low evidence of risk found by industry-funded studies and the higher evidence of risk found by independent studies[5].

2. The Spanish Labor Court in Madrid ruled 'permanent incapacitation' of a college professor who suffered from chronic fatigue and environmental and electromagnetic hypersensitivity[6].

3. A Dec 2011 study from the Keck School of Medicine, University of Southern California found that statistically significant annual increases in frontal and temporal lobe grade IV brain cancers (glioblastoma multiforme) from 1992 to 2006[7].

4. Another study published by IARC in 2012 reported that the brain's frontal and temporal lobe absorbs 69-72% of the total cellphone radiation absorbed by the brain depending on the carrier frequency of the cellphone[8].

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[2] *Ibid*
[3] *Ibid*
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5. On July 12, 2012, the American Academy of Pediatrics sent a letter to the Federal Communication Commission (FCC) urging that the FCC to open a "formal inquiry into radiation standards for cell phones and other wireless products" adding "The FCC has not assessed the standard for cell phone radiation since 1996."[9]

6. On March 29, 2013, the FCC issued a proposal to review its safety rules on cell phones based on new scientific findings in a Notice of Inquiry (NOI)[10].

7. The CTIA released its 2012 year-end survey on May 2nd 2013 reporting that there are now more wireless subscriber connections (326.4 million) in the U.S. than people, and more than 300,000 cell tower sites[11].

The City and County of San Francisco takes the health of its residents seriously. This is clear from the history of the SF Environment Code, particularly Section 100, ***mandating*** that the precautionary approach shall be used in making all decisions ***affecting the health of our residents*** including careful assessment of all available alternatives using the best available science and Section 101 where it articulates that its decisions shall protect against threats of ***serious or irreversible damage to its people regardless of full scientific certainty about cause and effect***. *Applicable Code therefore, in the light of these new WHO findings, requires that the City take action to protect its residents from commercial cellular device side effects, by providing notice sufficient to reasonably encourage safe use.*

The City of San Francisco, faces potential major liability costs in the millions of dollars for employees that may be diagnosed with a brain tumor that use cell phones as part of their work. A new peer-reviewed paper ([redacted]) by Devra Davis, Environmental Health Trust, Santos Kesari from the University of California San Diego, Division of Neuro-Oncology and other experts (which was hand-delivered to the Rules Committee of the Board of Supervisors on April 17, 2013) reports medical cost data estimates

> *"...treatment for a single case of brain cancer can cost between $100,000 for radiation therapy alone and up to $1 million depending on drug costs, resources to address this illness are already in short supply and not universally available in either developing or developed countries."*[12]

It is relevant to note that on February 26, 2013, Verizon Communications Inc reported the following liability risk in its Annual Report to the US Securities and Exchange Commission (US SEC)[13],

> *"...our wireless business also faces personal injury and consumer class action lawsuits relating to alleged health effects of wireless phones or radio frequency transmitters, and class action lawsuits that challenge marketing practices and disclosures relating to alleged adverse health effects of*

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[9] http://www.scribd.com/doc/104230961/American-Academy-of-Pediatrics-letter-to-the-FCC
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handheld wireless phones. We may incur significant expenses in defending these lawsuits. In addition, we may be required to pay significant awards or settlements."

In light of these materially changed circumstances, towards the goal of saving lives in San Francisco, we urge that the Board continue to ensure the public right to know about cell phone safety and assist in promoting broad public understanding of basic precautions that can be taken to reduce radiation exposure from cell phones. People have a right to know about ways to use phones more safely that are currently embedded within phones or in printed in small type in pamphlets they receive after purchasing these devices. We applaud your efforts to promote this basic right.

Very truly yours,

Stanton A. Glantz, PhD: Professor, Department of Medicine; American Legacy Foundation; Distinguished Professor in Tobacco Control; and Director, Center for Tobacco Control Research and Education, University of California, San Francisco (UCSF).

Erik Peper, PhD: Professor; Director of Business Development; Advisor International Olympic Committee; San Francisco State University (SFSU).

Devra Lee Davis, PhD, MPH: Founder and President Environmental Health Trust; Presidential Appointee.

David O. Carpenter, M.D.: Director, Institute for Health and the Environment, University at Albany

Morando Soffritti, MD: Professor and Scientific Director Ramazzini Institute, Bologna, Italy; and General Secretary Collegium Ramazzini, Bologna, Italy.

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Annie J. Sasco, MD, MPH, ScM, DrPH: Director of Research Epidemiology for Cancer Prevention, Inserm (French NIH) Bordeaux University, France; former IARC Unit Chief; and former Acting Chief, WHO Program for Cancer Control.

Darius Leszcynski, PhD: IARC Expert Advisor.

Elihu Richter, MD: Hadassah Medical Center, School of Public Health, Israel.

Yael Stein, MD: Hadassah Medical Center, School of Public Health, Israel.

Prof. Dr. Nesrin SEYHAN: Medical Faculty of Gazi University, Founding Chair, Biophysics Dept.; Founding Director, GNRK Center; Panel Member, NATO STO HFM; Scientific Secretariat Member, ICEMS; Advisory Committee Member, WHO EMF.

Prof. Dr. Süleyman Kaplan: JECM Editor; President of Turkish Society for Stereology; Director of Health Sciences Institute, Ondokuz Mayıs University; Head of Department of Histology and Embryology, Ondokuz Mayıs University, Samsun, Turkey.

Igor Beliaev, Dr.Sc.: Cancer Research Institute at Slovak Academy of Science, Slovak Republic.

Estie Sid Hudes, PhD MPH: Specialist / Statistician, Center for AIDS Prevention Studies (CAPS) & Department of Epidemiology & Biostatistics, University of California, San Francisco

Ted Schettler MD, MPH: Science Director, Science and Environmental Health Network

Martin Blank, PhD: Columbia University, New York

Dr. Ronald Herberman, MD: President for Research and Development TNI Bio Tech Inc., Bethesda, Maryland, Founding Director Emeritus at the University of Pittsburgh Cancer Institute.

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TO: Los Angeles Unified School District
FROM: Martha R Herbert, PhD, MD
RE: Wireless vs. Wired in Classrooms
DATE: February 8, 2013

I am a pediatric neurologist and neuroscientist on the faculty of Harvard Medical School and on staff at the Massachusetts General Hospital. I am Board Certified in Neurology with Special Competency in Child Neurology, and Subspecialty Certification in Neurodevelopmental Disorders.

I have an extensive history of research and clinical practice in neurodevelopmental disorders, particularly autism spectrum disorders. I have published papers in brain imaging research, in physiological abnormalities in autism spectrum disorders, and in environmental influences on ndurodevelopmental disorders such as autism and on brain development and function.

I recently accepted an invitation to review literature pertinent to a potential link between Autism Spectrum Disorders and Electromagnetic Frequencies (EMF) and Radiofrequency Radiation (RFR). I set out to write a paper of modest length, but found much more literature than I had anticipated to review. I ended up producing a 60 page single spaced paper with over 550 citations. It is available at http://www.bioinitiative.org/report/wp-content/uploads/pdfs/sec20_2012_Findings_in_Autism.pdf.

In fact, there are thousands of papers that have accumulated over decades – and are now accumulating at an accelerating pace, as our ability to measure impacts become more sensitive – that document adverse health and neurological impacts of EMF/RFR. Children are more vulnerable than adults, and children with chronic illnesses and/or neurodevelopmental disabilities are even more vulnerable. Elderly or chronically ill adults are more vulnerable than healthy adults.

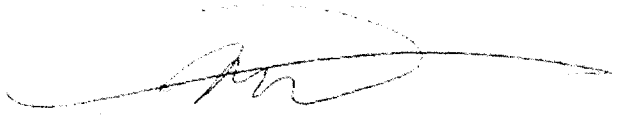
Current te chnologies were designed and promulgated without taking account of biological impacts other than thermal impacts. We now know that there are a large array of impacts that have nothing to do with the heating of tissue. The claim from wifi proponents that the only concern is thermal impacts is now definitively outdated scientifically.

EMF/RFR from wifi and cell towers can exert a disorganizing effect on the ability to learn and remember, and can also be destabilizing to immune and metabolic function. This will make it harder for some children to learn, particularly those who are already having problems in the first place.

Powerful industrial entities have a vested interest in leading the public to believe that EMF/RFR, which we cannot see, taste or touch, is harmless, but this is not true. Please do the right and precautionary thing for our children

I urge you to step back from your intention to go wifi in the LAUSD, and instead opt for wired technologies, particularly for those subpopulations that are most sensitive. It will be easier for you to make a healthier decision now than to undo a misguided decision later.

Thank you.



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July 12, 2012

The Honorable Julius Genachowski
Commissioner
Federal Communications Commission
445 12th Street SW
Washington, DC 20554

Dear Chairman Genachowski:

The American Academy of Pediatrics (AAP), a non-profit professional organization of 60,000 primary care pediatricians, pediatric medical sub-specialists, and pediatric surgical specialists dedicated to the health, safety and well-being of infants, children, adolescents, and young adults strongly supports the proposal for a formal inquiry into radiation standards for cell phones and other wireless products. The Academy encourages the Federal Communications Commission (FCC) to vote to move forward with this inquiry in an expeditious manner.

The FCC has not assessed the standard for cell phone radiation since 1996. According to industry groups, approximately 44 million people had mobile phones when the standard was set; today, there are more than 300 million mobile phones in use in the United States. While the prevalence of wireless phones and other devices has sky-rocketed, the behaviors around cell phone uses have changed as well. The number of mobile phone calls per day, the length of each cell phone call, and the amount of time people use mobile phones has increased, while cell phone and wireless technology has undergone substantial changes. Many more people, especially adolescents and young adults, now use cell phones as their only phone line and they begin using wireless phones at much younger ages.

The FCC standard for maximum radiation-exposure levels are based on the heat emitted by mobile phones. These guidelines specify exposure limits for hand-held wireless devices in terms of the Specific Absorption Rate (SAR), which measures the rate the body absorbs radiofrequency (RF). The current allowable SAR limit is 1.6 watts per kilogram (W/kg), as averaged over one gram of tissue. Although wireless devices sold in the United States must ensure that they do not exceed the maximum allowable SAR limit when operating at the device's highest possible power level, concerns have been raised that long-term RF exposure at this level affects the brain and other tissues and may be connected to types of brain cancer, including glioma and meningioma.

In the past few years, a number of American and international health and scientific bodies have contributed to the debate over cell phone radiation and its possible link to cancer. The International Agency for Research on Cancer (IARC), part of the

United Nations' World Health Organization, said in June 2011 that a family of frequencies that includes mobile-phone emissions is "possibly carcinogenic to humans." The National Cancer Institute has stated that although studies have not demonstrated that RF energy from cell phones definitively causes cancer, more research is needed because cell phone technology and cell phone use are changing rapidly. While a definitive link between cell phone radiation and brain cancer has not been established, these studies and others clearly demonstrate the need for further research into this area and highlight the importance of reassessing the current SAR to determine if it is protective of human health.

The AAP believes the inquiry to reassess the radiation standard presents an opportunity to review its impacts on children's health and well-being. In the past, such standards have generally been based on the impact of exposure on an adult male. Children, however, are not little adults and are disproportionately impacted by all environmental exposures, including cell phone radiation. In fact, according to IARC, when used by children, the average RF energy deposition is two times higher in the brain and 10 times higher in the bone marrow of the skull, compared with mobile phone use by adults. While the Academy appreciates that the FCC is considering investigating whether the emission standards should be different for devices primarily used by children, it is essential that any new standard for cell phones or other wireless devices be based on protecting the youngest and most vulnerable populations to ensure they are safeguarded throughout their lifetimes.

Finally, in reviewing the SAR standard, the FCC has the opportunity to highlight the importance of limiting media use among children. The Academy has found potentially negative effects and no known positive effects of media use by children under the age of two, including television, computers, cell phones, and other handheld wireless devices. In addition, studies consistently show that older children and adolescents utilize media at incredibly high rates, which potentially contributes to obesity and other health and developmental risks. In reviewing the SAR limit, the FCC has the opportunity to improve the health of our nation by highlighting the importance of limiting screen time and media use for children and adolescents.

The AAP supports the proposal for a formal inquiry into radiation standards for cell phones and other wireless products and the Academy encourages the FCC to vote in favor of moving forward with this investigation. If you have questions or concerns, please contact Kristen Mizzi in the AAP's Washington Office at 202/347-8600.

Sincerely,

Robert W. Block, MD FAAP
President

RWB/km

CC: Commissioner Robert M. McDowell
Commissioner Mignon Clyburn
Commissioner Jessica Rosenworcel
Commissioner Ajit Pai

American Academy of Pediatrics
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Fayetteville, GA

December 12, 2012

The Honorable Dennis Kucinich
2445 Rayburn House Office Building
Washington, DC 20515

Dear Representative Kucinich:

On behalf of the American Academy of Pediatrics (AAP), a non-profit professional organization of 60,000 primary care pediatricians, pediatric medical sub-specialists, and pediatric surgical specialists dedicated to the health, safety and well-being of infants, children, adolescents, and young adults, I would like to share our support of H.R. 6358, the *Cell Phone Right to Know Act.*

The AAP strongly supports H.R. 6358's emphasis on examining the effects of radiofrequency (RF) energy on vulnerable populations, including children and pregnant women. In addition, we are pleased that the bill would require the consideration of those effects when developing maximum exposure standards. Children are disproportionately affected by environmental exposures, including cell phone radiation. The differences in bone density and the amount of fluid in a child's brain compared to an adult's brain could allow children to absorb greater quantities of RF energy deeper into their brains than adults. It is essential that any new standards for cell phones or other wireless devices be based on protecting the youngest and most vulnerable populations to ensure they are safeguarded through their lifetimes.

In addition, the AAP supports the product labeling requirements in H.R. 6358. These standards will ensure consumers can make informed choices in selecting mobile phone purchases. They will also enable parents to better understand the potential dangers of RF energy exposure and protect their children.

On July 24, the U.S. Government Accountability Office (GAO) published a report on federal cell phone radiation exposure limits and testing requirements. The GAO noted that the Federal Communications Commission's (FCC) most recent data indicates that the number of estimated mobile phone subscribers has grown from approximately 3.5 million in 1989 to approximately 289 million at the end of 2009. Cell phone use behaviors have also changed during that time. The quantity and duration of cell phone calls has increased, as has the amount of time people use mobile phones, while cell phone and wireless technology has undergone substantial changes. Many more people, especially adolescents and young adults, now use cell phones as their only phone line, and they begin using wireless phones at much younger ages.

Despite these dramatic changes in mobile phone technology and behavior, the FCC has not revisited the standard for cell phone radiation exposure since 1996. The current FCC standard for maximum radiation exposure levels is based on the heat emitted by mobile phones. These guidelines specify exposure limits for hand-held wireless devices in terms of the Specific Absorption Rate (SAR), which measures the rate the body absorbs radiofrequency (RF). The current allowable SAR limit is 1.6 watts per kilogram (W/kg), as averaged over one gram of tissue. Although wireless devices sold in the United States must ensure that they do not exceed the maximum allowable SAR limit when operating at the device's highest possible power level, concerns have been raised that long-term RF energy exposure at this level affects the brain and other tissues and may be connected to types of brain cancer, including glioma and meningioma.

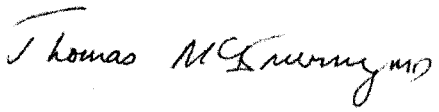
In May 2011, the International Agency for Research on Cancer (IARC), the United Nations' World Health Organization's (WHO) agency promoting international cancer research collaboration, classified RF energy as "possibly carcinogenic to humans." In addition, the National Cancer Institute has stated that although studies have not definitively linked RF energy exposure from cell phones to cancer, more research is required to address rapidly changing cell phone technology and use patterns.

This and other research identified by the GAO demonstrates the need for further research on this issue, and makes clear that exposure standards should be reexamined.

The GAO concluded that the current exposure limits may not reflect the latest research on RF energy, and that current mobile phone testing requirements may not identify maximum RF energy exposure. The GAO proposed that the FCC formally reassess its limit and testing requirements to determine whether they are effective. The AAP commends the activities proposed under H.R. 6358, as they would address this research gap and improve consumer knowledge and safety. Establishing an expanded federal research program as the basis for exposure standards will ensure that consumer protections incorporate the latest research. Currently, the National Institute of Health (NIH), the only federal agency the GAO identified as directly funding research on this topic, provided approximately $35 million from 2001 to 2011. Given this previous funding level, the AAP supports the $50 million per fiscal year for seven years that H.R. 6358 would authorize.

The AAP appreciates your recognition of the need for new research and standards for mobile phone radiation, and is pleased to support H.R. 6358. For further assistance, please do not hesitate to contact Sonya Clay, Assistant Director, Department of Federal Affairs, at 202-347-8600 or sclay@aap.org.

Sincerely,



Thomas K. McInerny, MD, FAAP
President

International Agency for Research on Cancer

World Health Organization

PRESS RELEASE
N° 208

31 May 2011

IARC CLASSIFIES RADIOFREQUENCY ELECTROMAGNETIC FIELDS AS POSSIBLY CARCINOGENIC TO HUMANS

Lyon, France, May 31, 2011 -- The WHO/International Agency for Research on Cancer (IARC) has classified radiofrequency electromagnetic fields as possibly carcinogenic to humans (Group 2B), based on an increased risk for glioma, a malignant type of brain cancer[1], associated with wireless phone use.

Background

Over the last few years, there has been mounting concern about the possibility of adverse health effects resulting from exposure to radiofrequency electromagnetic fields, such as those emitted by wireless communication devices. The number of mobile phone subscriptions is estimated at 5 billion globally.

From May 24–31 2011, a Working Group of 31 scientists from 14 countries has been meeting at IARC in Lyon, France, to assess the potential carcinogenic hazards from exposure to radiofrequency electromagnetic fields. These assessments will be published as Volume 102 of the IARC *Monographs*, which will be the fifth volume in this series to focus on physical agents, after Volume 55 (Solar Radiation), Volume 75 and Volume 78 on ionizing radiation (X-rays, gamma-rays, neutrons, radio-nuclides), and Volume 80 on non-ionizing radiation (extremely low-frequency electromagnetic fields).

The IARC Monograph Working Group discussed the possibility that these exposures might induce long-term health effects, in particular an increased risk for cancer. This has relevance for public health, particularly for users of mobile phones, as the number of users is large and growing, particularly among young adults and children.

The IARC Monograph Working Group discussed and evaluated the available literature on the following exposure categories involving radiofrequency electromagnetic fields:

- occupational exposures to radar and to microwaves;
- environmental exposures associated with transmission of signals for radio, television and wireless telecommunication; and
- personal exposures associated with the use of wireless telephones.

International experts shared the complex task of tackling the exposure data, the studies of cancer in humans, the studies of cancer in experimental animals, and the mechanistic and other relevant data.

[1] 237 913 new cases of brain cancers (all types combined) occurred around the world in 2008 (gliomas represent 2/3 of these). Source: Globocan 2008

Results

The evidence was reviewed critically, and overall evaluated as being *limited*[2] among users of wireless telephones for glioma and acoustic neuroma, and *inadequate*[3] to draw conclusions for other types of cancers. The evidence from the occupational and environmental exposures mentioned above was similarly judged inadequate. The Working Group did not quantitate the risk; however, one study of past cell phone use (up to the year 2004), showed a 40% increased risk for gliomas in the highest category of heavy users (reported average: 30 minutes per day over a 10-year period).

Conclusions

Dr Jonathan Samet (University of Southern California, USA), overall Chairman of the Working Group, indicated that "the evidence, while still accumulating, is strong enough to support a conclusion and the 2B classification. The conclusion means that there could be some risk, and therefore we need to keep a close watch for a link between cell phones and cancer risk."

"Given the potential consequences for public health of this classification and findings," said IARC Director Christopher Wild, "it is important that additional research be conducted into the long-term, heavy use of mobile phones. Pending the availability of such information, it is important to take pragmatic measures to reduce exposure such as hands-free devices or texting. "

The Working Group considered hundreds of scientific articles; the complete list will be published in the Monograph. It is noteworthy to mention that several recent in-press scientific articles[4] resulting from the Interphone study were made available to the working group shortly before it was due to convene, reflecting their acceptance for publication at that time, and were included in the evaluation.

A concise report summarizing the main conclusions of the IARC Working Group and the evaluations of the carcinogenic hazard from radiofrequency electromagnetic fields (including the use of mobile telephones) will be published in The Lancet Oncology in its July 1 issue, and in a few days online.

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[2] '***Limited evidence of carcinogenicity***': A positive association has been observed between exposure to the agent and cancer for which a causal interpretation is considered by the Working Group to be credible, but chance, bias or confounding could not be ruled out with reasonable confidence.

[3] '***Inadequate evidence of carcinogenicity***': The available studies are of insufficient quality, consistency or statistical power to permit a conclusion regarding the presence or absence of a causal association between exposure and cancer, or no data on cancer in humans are available.

[4] a. 'Acoustic neuroma risk in relation to mobile telephone use: results of the INTERPHONE international case-control study' (the Interphone Study Group, in Cancer Epidemiology, *in press*)
b. 'Estimation of RF energy absorbed in the brain from mobile phones in the Interphone study' (Cardis et al., Occupational and Environmental Medicine, *in press*)
c. 'Risk of brain tumours in relation to estimated RF dose from mobile phones – results from five Interphone countries' (Cardis et al., Occupational and Environmental Medicine, *in press*)
d. 'Location of Gliomas in Relation to Mobile Telephone Use: A Case-Case and Case-Specular Analysis' (American Journal of Epidemiology, May 24, 2011. [Epub ahead of print].

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Link to the **audio file** posted shortly after the briefing:
http://terrance.who.int/mediacentre/audio/press_briefings/

About IARC

The International Agency for Research on Cancer (IARC) is part of the World Health Organization. Its mission is to coordinate and conduct research on the causes of human cancer, the mechanisms of carcinogenesis, and to develop scientific strategies for cancer control. The Agency is involved in both epidemiological and laboratory research and disseminates scientific information through publications, meetings, courses, and fellowships.

If you wish your name to be removed from our press release e-mailing list, please write to com@iarc.fr.

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IARC CLASSIFIES RADIOFREQUENCY ELECTROMAGNETIC FIELDS AS POSSIBLY CARCINOGENIC TO HUMANS

ABOUT THE IARC MONOGRAPHS

What are the IARC Monographs?

The *IARC Monographs* identify environmental factors that can increase the risk of human cancer. These include chemicals, complex mixtures, occupational exposures, physical and biological agents, and lifestyle factors. National health agencies use this information as scientific support for their actions to prevent exposure to potential carcinogens. Interdisciplinary working groups of expert scientists review the published studies and evaluate the weight of the evidence that an agent can increase the risk of cancer. The principles, procedures, and scientific criteria that guide the evaluations are described in the Preamble to the IARC Monographs.

Since 1971, more than 900 agents have been evaluated, of which approximately 400 have been identified as carcinogenic or potentially carcinogenic to humans.

Definitions

Group 1: The agent is *carcinogenic to humans*.

This category is used when there is *sufficient evidence of carcinogenicity* in humans. Exceptionally, an agent may be placed in this category when evidence of carcinogenicity in humans is less than *sufficient* but there is *sufficient evidence of carcinogenicity* in experimental animals and strong evidence in exposed humans that the agent acts through a relevant mechanism of carcinogenicity.

Group 2.

This category includes agents for which, at one extreme, the degree of evidence of carcinogenicity in humans is almost *sufficient*, as well as those for which, at the other extreme, there are no human data but for which there is evidence of carcinogenicity in experimental animals. Agents are assigned to either Group 2A (*probably carcinogenic to humans*) or Group 2B (*possibly carcinogenic to humans*) on the basis of epidemiological and experimental evidence of carcinogenicity and mechanistic and other relevant data. The terms *probably carcinogenic* and *possibly carcinogenic* have no quantitative significance and are used simply as descriptors of different levels of evidence of human carcinogenicity, with *probably carcinogenic* signifying a higher level of evidence than *possibly carcinogenic*.

Group 2A: The agent is *probably carcinogenic to humans*.

This category is used when there is *limited evidence of carcinogenicity* in humans and *sufficient evidence of carcinogenicity* in experimental animals. In some cases, an agent may be classified in this category when there is *inadequate evidence of carcinogenicity* in humans and *sufficient evidence of carcinogenicity* in experimental animals and strong evidence that the carcinogenesis is mediated by a mechanism that also operates in humans. Exceptionally, an agent may be classified in this category solely on the basis of *limited evidence of carcinogenicity* in humans. An agent may be assigned to this category if it clearly belongs, based on mechanistic considerations, to a class of agents for which one or more members have been classified in Group 1 or Group 2A.

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Group 2B: The agent is *possibly carcinogenic to humans*.

This category is used for agents for which there is *limited evidence of carcinogenicity* in humans and less than *sufficient evidence of carcinogenicity* in experimental animals. It may also be used when there is *inadequate evidence of carcinogenicity* in humans but there is *sufficient evidence of carcinogenicity* in experimental animals. In some instances, an agent for which there is *inadequate evidence of carcinogenicity* in humans and less than *sufficient evidence of carcinogenicity* in experimental animals together with supporting evidence from mechanistic and other relevant data may be placed in this group. An agent may be classified in this category solely on the basis of strong evidence from mechanistic and other relevant data.

Group 3: The agent is *not classifiable as to its carcinogenicity to humans*.

This category is used most commonly for agents for which the evidence of carcinogenicity is *inadequate* in humans and *inadequate* or *limited* in experimental animals.

Exceptionally, agents for which the evidence of carcinogenicity is *inadequate* in humans but *sufficient* in experimental animals may be placed in this category when there is strong evidence that the mechanism of carcinogenicity in experimental animals does not operate in humans.

Agents that do not fall into any other group are also placed in this category.

An evaluation in Group 3 is not a determination of non-carcinogenicity or overall safety. It often means that further research is needed, especially when exposures are widespread or the cancer data are consistent with differing interpretations.

Group 4: The agent is probably not carcinogenic to humans.

This category is used for agents for which there is *evidence suggesting lack of carcinogenicity* in humans and in experimental animals. In some instances, agents for which there is *inadequate evidence of carcinogenicity* in humans but *evidence suggesting lack of carcinogenicity* in experimental animals, consistently and strongly supported by a broad range of mechanistic and other relevant data, may be classified in this group.

Definitions of evidence, as used in IARC Monographs for studies in humans

The evidence relevant to carcinogenicity from studies in humans is classified into one of the following categories:

Sufficient evidence of carcinogenicity: The Working Group considers that a causal relationship has been established between exposure to the agent and human cancer. That is, a positive relationship has been observed between the exposure and cancer in studies in which chance, bias and confounding could be ruled out with reasonable confidence. A statement that there is *sufficient evidence* is followed by a separate sentence that identifies the target organ(s) or tissue(s) where an increased risk of cancer was observed in humans. Identification of a specific target organ or tissue does not preclude the possibility that the agent may cause cancer at other sites.

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Limited evidence of carcinogenicity: A positive association has been observed between exposure to the agent and cancer for which a causal interpretation is considered by the Working Group to be credible, but chance, bias or confounding could not be ruled out with reasonable confidence.

Inadequate evidence of carcinogenicity: The available studies are of insufficient quality, consistency or statistical power to permit a conclusion regarding the presence or absence of a causal association between exposure and cancer, or no data on cancer in humans are available.

Evidence suggesting lack of carcinogenicity: There are several adequate studies covering the full range of levels of exposure that humans are known to encounter, which are mutually consistent in not showing a positive association between exposure to the agent and any studied cancer at any observed level of exposure. The results from these studies alone or combined should have narrow confidence intervals with an upper limit close to the null value (e.g. a relative risk of 1.0). Bias and confounding should be ruled out with reasonable confidence, and the studies should have an adequate length of follow-up. A conclusion of *evidence suggesting lack of carcinogenicity* is inevitably limited to the cancer sites, conditions and levels of exposure, and length of observation covered by the available studies. In addition, the possibility of a very small risk at the levels of exposure studied can never be excluded.

In some instances, the above categories may be used to classify the degree of evidence related to carcinogenicity in specific organs or tissues.

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Italy: Supreme Court Ruling on Mobile Phones and Tumors

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http://www.loc.gov/lawweb/servlet/lloc_news?disp3_l205403378_text

(Oct 23, 2012)

On October 18, 2012, it was reported that Italy High Court Finds Causal Link Between Mobile Phones and Cancer, PAPER CHASE NEWSBURST (Oct. 19, 2012).)

The appellant in the case, former Brescian company director Innocenzo Marcolini, discovered in 2002 that he had developed a "neurinoma," a benign tumor that arises from the cells of a nerve sheath, in this case the Gasser's ganglion of the trigeminal nerve. (*Neurinoma*, THE PROBERT ENCYCLOPEDIA OF MEDICINE (last visited Oct. 23, 2012); *Manager bresciano risarcito per un tumore provocato dall'uso del cellulare*, IL GIORNO (Oct. 18, 2012), .) Even though the tumor was deemed non-cancerous, it "nevertheless required surgery that badly affected his quality of life." (Virginia Alimenti, Naomi O'Leary, & Kate Kelland, *Italy Court Ruling Links Mobile Phone Use to Tumor*, REUTERS (Oct. 19, 2012).)

Marcolini's application to the Italian Workers' Compensation Authority, INAIL, for financial compensation was turned down on the ground of lack of evidence that the tumor was work-related, but a Brescian court subsequently held that a causal link did exist between mobile and cordless phone use and tumors. INAIL's appeal against that decision was rejected by the Supreme Court on October 12, 2012. (*Id.*)

In upholding the lower court's decision, the Supreme Court held "that scientific evidence advanced in support of the claim was reliable" and that "Marcolini's situation had been 'different from normal, non-professional use of a mobile telephone.'" (*Id.*) That evidence was based chiefly on studies done by a Swedish group of cancer specialists, led by Lennart Hardell, between 2005 and 2009. (DeRight, *supra*; Lennart Hardell, *Long-Term Use of Cellular and Cordless Phones and the Risk of Brain Tumours* [Power Point presentation] (last visited Oct. 23, 2012).) The Court deemed their work to be independent and not, like some others' research, "co-financed by the same companies that produce mobile telephones." (Alimenti et al., *supra*.)

Scientific opinion remains divided, however, as to the strength of the causal tie between mobile phone use and tumors. In response to the Italian ruling, Malcolm Sperrin, director of medical physics and clinical engineering at the Royal Berkshire Hospital in Great Britain, noted, "[g]reat caution is needed before we jump to conclusions about mobile phones and brain tumors." (*Id.*) In May 2011, moreover, the International Agency for Research on Cancer (IARC) of the World Health Organization made the cautious announcement in a press release that it had classified radiofrequency electromagnetic fields, of the sort used by wireless phones, as only "possibly carcinogenic to humans." (Press Release, IARC, IARC Classifies Radiofrequency Electromagnetic Fields as Possibly Carcinogenic to Humans (May 31, 2011).)

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REVIEW

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LONG-TERM EXPOSURE TO MICROWAVE RADIATION PROVOKES CANCER GROWTH: EVIDENCES FROM RADARS AND MOBILE COMMUNICATION SYSTEMS

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In this review we discuss alarming epidemiological and experimental data on possible carcinogenic effects of long term exposure to low intensity microwave (MW) radiation. Recently, a number of reports revealed that under certain conditions the irradiation by low intensity MW can substantially induce cancer progression in humans and in animal models. The carcinogenic effect of MW irradiation is typically manifested after long term (up to 10 years and more) exposure. Nevertheless, even a year of operation of a powerful base transmitting station for mobile communication reportedly resulted in a dramatic increase of cancer incidence among population living nearby. In addition, model studies in rodents unveiled a significant increase in carcinogenesis after 17-24 months of MW exposure both in tumor-prone and intact animals. To that, such metabolic changes, as overproduction of reactive oxygen species, 8-hydroxi-2-deoxyguanosine formation, or ornithine decarboxylase activation under exposure to low intensity MW confirm a stress impact of this factor on living cells. We also address the issue of standards for assessment of biological effects of irradiation. It is now becoming increasingly evident that assessment of biological effects of non-ionizing radiation based on physical (thermal) approach used in recommendations of current regulatory bodies, including the International Commission on Non-Ionizing Radiation Protection (ICNIRP) Guidelines, requires urgent reevaluation. We conclude that recent data strongly point to the need for re-elaboration of the current safety limits for non-ionizing radiation using recently obtained knowledge. We also emphasize that the everyday exposure of both occupational and general public to MW radiation should be regulated based on a precautionary principles which imply maximum restriction of excessive exposure.

Key Words: **non-ionizing radiation, radiofrequency, tumor, risk assessment, safety limits, precautionary principle.**

INTRODUCTION

Electromagnetic radiation (EMR) became one of the most significant and fastest growing environmental factors due to intensive development of communication technologies during the last decades. Currently, according to expert estimations, the level of electromagnetic radiation from artificial sources exceeds the level of natural electromagnetic fields by thousand folds. The active development of mobile communication technologies over the world will only raise this level further. In this connection the problem of possible adverse effects of anthropogenic EMR on human health and particularly strictest assessment of possible carcinogenic effects of EMR is extremely important.

In August 2007 an international working group of renowned scientists and public health experts released a report on electromagnetic fields (EMF) and human health [1]. It raised a serious concern about safety limits for public electromagnetic irradiation from power lines, cell phones, radars, and other sources of EMF exposure in daily life. The authors concluded that the existing public safety limits were inadequate to protect public health. Moreover, very recently a vast number of new extremely important studies in this field have been published. Importantly, nowadays the problem is discussed on highest political level over the world. It appears that the most sound political document in Europe is a European Parliament Resolution from April 2, 2009 (*www.europarl.europa.eu*), where the direct appeals to activate the research and business strategy for effective solving of the problem over the member states were indicated.

In this review we would like to analyze the results of studies on specific biological effects of microwaves (MW), both epidemiological and experimental that deal with cancer promotion by long term low intensity microwave irradiation of human/animal beings. We will concentrate on unequivocal studies and will not analyze ambiguous data. For additional analysis of microwave risks we can recommend recently published reviews [2–10].

MICROWAVES OF RADARS AND MOBILE COMMUNICATION SYSTEMS

Microwaves are non-ionizing electromagnetic radiation. That means MW is a type of electromagnetic radiation which does not carry enough energy

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Abbreviations used: 8-OH-dG — 8-hydroxi-2-deoxyguanosine; EGF — epidermal growth factor; EMF — electromagnetic field; EMR — electromagnetic radiation; ERK — extracellular-signal-regulated kinase; GSM — Global System for Mobile communication; ICNIRP — International Commission on Non-Ionizing Radiation Protection; MW — microwaves; NHL — Non-Hodgkin lymphoma; ODC — ornithine decarboxylase; OER — observed expected ratio; OR — odds ratio; ROS — reactive oxygen species; SAR — specific absorption rate; SIR — standardized incidence ratio; SMR — standardized mortality ratio; WHO — the World Health Organization.

for ionization of atoms and molecules under normal conditions and unlike the ionizing radiation this kind of radiation generally has not enough energy for breaking the intermolecular bonds or for breakaway of electrons from atoms or molecules. MW comprise a part of radiofrequency range. Radiofrequency radiation (RF) refers to electromagnetic waves with a rate of oscillation of electromagnetic fields in the range from 30 kHz to 300 GHz. As any other electromagnetic waves, the radio waves are pulses of electric and magnetic fields. These fields regenerate each other as they move through the space at the speed of light. MW have frequencies from 300 MHz to 300 GHz. As MW have the highest frequency among other RF, it carries the highest energy and produce most thermal effect upon interaction with the matter.

The main sources of radiofrequency radiation during a long period in previous century were broadcasting systems. In some cases, for example, in military and aviation the most powerful local sources of radiofrequency radiation were and still are radars (RAdio Detection And Ranging). However, the situation changed dramatically for general population during recent decades; and currently the most prevailing sources of RF in nearest human environment are mobile communication systems. It is important that both radars and systems for mobile communication use the same microwave part of radiofrequency spectrum.

Radar systems are type of powerful sources of pulsed MW which generally effect only certain groups of military or service staff or population living nearby. Radars are detection systems which use MW to determine both moving and fixed objects like aircraft, ships, missiles, etc. Depending on the tasks they use different frequencies of MW, from ~1 GHz to ~12 GHz.

Mobile communication systems are undoubtedly the most source of MW in human environment over the world nowadays. Starting from the first commercial mobile phone networks in Japan, Europe and USA since 1979–1983 the number of active users of mobile telephony increased globally to over five billion. In developed countries the number of cellular phone users today is over the point of saturation. It means that many people use more than one cell phone. The initial age of youngest users of cell phone is estimated as three years old [5].

Mobile communication technology utilizes MW for connection of cell phones and base transmitting stations. Phone refers to as mobile because it is free from wire connection and it refers to as cellular/cell because technology utilizes cellular network principle. All area is covered by many base transmitting stations, each station operates in one cell (part of area) and cell phone automatically changes the station when moves from one cell to another. In GSM (Global System for Mobile communication) standard, which covers about 80% of all services over the world the frequencies of electromagnetic waves used are about 850; 900; 1850; or 1900 MHz, which belongs to the microwave range. The useful information (sounds or images) is transferred by modulation of electromagnetic wave frequency. In GSM standard TDMA (Time Division Multiple Access) principle is realized. This means a part-time access of each consumer to the logical channel with frequency of channel rotation about 217 Hz. Thus, both base transmitting stations and cell phones emit MW modulated according to the digital standard.

SAFETY LIMITS FOR MICROWAVE RADIATION

The main international recommendations on safety levels of non-ionizing electromagnetic radiation is *Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields (up to 300 GHz)* of International Commission on Non-Ionizing Radiation Protection [11]. The document gives recommended safety limits in all ranges of EMR both for occupational and general public exposure. "Basis for limitation exposure" is dramatically important for understanding the imperfection of this document. Accordingly, the document directly states that "Induction of cancer from long-term EMF exposure was not considered to be established, and so these guidelines are based on short-term, immediate health effects such as stimulation of peripheral nerves and muscles, shocks and burns caused by touching conducting objects, and elevated tissue temperatures resulting from absorption of energy during exposure to EMF." However, the basic assumption of that is questioned nowadays by numerous data sources.

According to that document a few parameters of EMR energy are recommended to be restricted. Among them the two parameters are used the most often: 1) Specific Absorption Rate (SAR) in W/kg, which indicates the EMR energy absorbed per mass unit of human tissue per second; and 2) power density or intensity of incident radiation in W/m^2 (or $\mu W/cm^2$) which indicates the amount of electromagnetic energy which falls on a unit of surface (under the right angle) per second. SAR safety limit for general public exposure indicated in Guidelines as 2 W/kg (for head and trunk) for the microwave range. To that, this limit is accepted by industry as mandatory for every commercial cell phone over the world, and real value of SAR of each cell phone model must be indicated in technical specification of the model. Unfortunately, SAR is rather sophisticated index for measurement. Moreover, only models of adult human head are currently used by industry for calculation of SAR, while real SAR values depend on a geometry and structure of tissues and, for example, was shown to be much higher for a child head than for the adult one [12–14].

Power density, or intensity of radiation, is much more direct and simple index as compared to SAR, although it does not estimate the specificity of interaction of EMR and the matter. Occupational exposure limits in microwave range according to ICNIRP are 10–50 W/m^2. Public exposure limits for microwaves according to ICNIRP recommendation were set to 2–10 W/m^2 (or 200–1000 $\mu W/cm^2$) depending on fre-